

STUDY ON THE MANAGEMENT OF EPC PROJECTS

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ABSTRACT

Procurement system in construction industry can be categorized into several methods. One of them is EPC (engineering, procurement and construction). EPC is a type of construction contract where the contractor is responsible for engineering services, procurement of materials, and construction. Power plants, factories, gas development project, infrastructure projects, and industrial plant construction sectors are the typical examples of EPC projects. With its rapid development, Indonesia needs many industrial public sector projects. Especially with the population over 230 million people and blessed with so many natural resources, its demand for power plant projects, gas development projects, and other type of industrial sector projects has risen significantly. Meanwhile, PT Waskita Karya (Persero) is one of the main leading construction company in Indonesia and it just recently established EPC Division in 2011. Therefore, this research aims to (1) identify the nature of EPC projects, (2) identify EPC projects management system as applied in Waskita, and (3) determine the strategies which can improve the effectiveness of EPC business process. The findings of this research are (1) there are 34 (thirty four) EPC projects' characteristics, in which 10 (ten) of them are specifically only found in EPC projects; (2) EPC projects in Waskita are quite different in their implementation, where for some projects, EPC Division serves only engineering and procurement phases; and (3) the improvement strategies can be divided into 3 (three) groups, namely: for contractor with 15 strategies, for employer with 5 strategies, and for both parties with 6 strategies. At the end, this research is important for all players to face the increase popularity of EPC project procurement.

KEYWORDS: EPC, Project Characteristics, Project Strategies, Waskita, Procurement

INTRODUCTION

A project can be defined as a group of interrelated activities constraint by a specific budget, scope, schedule and other related factors to achieve certain goals. It can be categorized into several ways. Each categories has their own determinants and demand factors. One of them is EPC.

EPC is the abbreviation for *Engineering, Procurement and Construction*. EPC is a type of construction contract where the contractor holds the responsibility for engineering services, procurement of materials, and construction. Power plants, factories, gas development project, infrastructure projects, and industrial plant construction sectors are the typical examples of EPC projects. Accordance with the improvement of construction delivery systems, EPC type of contract is more widely used all over the world. One of the main reasons is that it will distribute the employer's risk to the main contractor. By this way, employer expects to get a higher degree of certainty as to costs and time, and the contractor takes full responsibility for the engineering (design), procurement and construction (execution) phases of the project. The popularity of this procurement method has made organizations such as FIDIC to respond the need for appropriate standard form of construction contract that are more closely reflected today's market conditions, namely FIDIC Conditions of Contract for EPC/Turnkey Contracts (the Silver Book).

There are three main aspects which should be considered in executing any project, i.e. the TCP Triangle which stands for time, cost, and performance aspects in a project. In order to get a project successfully completed, a good project management implementation is needed. PMI as in PMBOK Guide 2008 (p.6) [1] has defined *project management* as the implementation of construction-related knowledge, skills, tools, and techniques to project activities with the aims to meet the project requirements. Project management is accomplished through the appropriate application and integration of the 5 (five) process groups; i.e. initiating, planning, executing, monitoring & controlling, and closing.

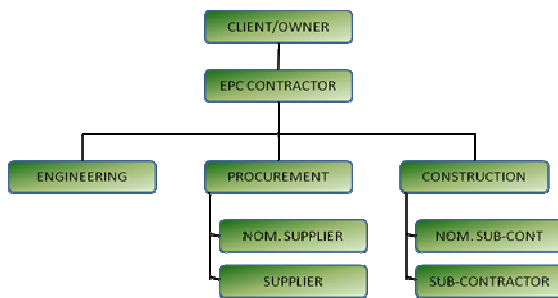


Figure 1: Typical EPC Project Organization

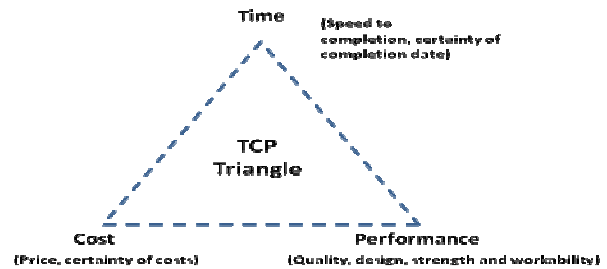


Figure 2: The TCP Project Triangle

The project implementation process is very complex and requiring simultaneous attention to a wide variety of human interactions, budgetary issues, and technical variables. As a result, it is important that the project manager would be well served by more information about project specific factors critical to project success. The project manager needs the necessary tools to assist him or her to focus his or her attention on important areas and set differential priorities across different project elements as discussed by Jeffrey and Dennis [2].

Project management implementation for EPC projects is quite different with project management implementation for building and civil works. In traditional procurement system, whether for building and civil works, design will be prepared by the employer and his architects. However this is quite different in EPC projects. design is prepared by both the architect and contractor with the main responsibility will be fall to contractor. Plus, in EPC projects usually applies the contractor will finance some or whole of the project cost and only will be paid after the completion of the project.

PT Waskita Karya (Persero) is one of the main leading construction company in Indonesia and has many advantages as one of the state-owned companies. Since its establishment on 1st January 1961, it has become one of the leading construction companies which play a major role in the development of Indonesia. The demand for EPC projects has been growing recently, especially for power plant projects. With this rapid growth of EPC projects demand, Waskita has made strategic company policy to establish its own division for EPC projects. For this reason, Waskita needs a scholastic management and learning. Waskita has so many experiences over its 50 years operation in building and civil engineering works. However, it must admit that EPC projects have not been in its scope of operation before and therefore it does not fully understand the nature of EPC projects.

The aim of this research is to study the project management system for EPC projects. While the objectives of this research are (1) to identify the nature of EPC projects, (2) to identify the management system for EPC projects as applied by PT Waskita Karya, and (3) to improve the effectiveness of the business process for EPC projects. In order to direct the research focus, research limitation should be arranged as follows: (1) the research is limited for EPC project only which is very different with other types of construction categorization, (2) the project data are taken from PT Waskita Karya (Persero) as one of the main leading construction company in Indonesia, and (3) the method used for collecting data

consists mainly of two techniques, i.e. expert interview and legitimate data (company and project data).

The importance of the research is mainly to identify the nature and problems in EPC projects and by doing so it will eventually improve the project delivery system for EPC projects. This research will result in the implementation of project management for EPC projects which is still seldom be researched before.

LITERATURE REVIEW

The dictionary definition of *procurement* is ‘the obtaining of goods and services’. Put into a construction context this can be taken to mean obtaining the whole spectrum of goods, materials, plant and services in order to design, build and commission a building that delivers the best possible value for money for the client over its life cycle (Duncan, 2009). While Masterman [3] described *project procurement* as the organizational structure needed to design and build construction projects for a specific client. In other words, *project procurement* can be defined as the process of obtaining and providing a certain project starting from the pre-construction until the post-construction of the project. EPC actually is a variant of ‘*Design and Build*’ procurement system. According to Masterman (1996), the term ‘*design and build*’ has been interpreted and defined as being “an arrangement where one contracting organization takes sole responsibility, normally on a lump sum fixed price basis, for the *bespoke* design and construction of a client’s project”. Due to the development of construction project and procurement systems, this type of procurement has also been developed into some more variants, namely *Package Deals*, *Turnkey*, *EPC*, and *Develop and Construct*.

In EPC, the contractor holds all responsibility from the beginning. It includes the provision of engineering services, materials procurement and construction services. With the rapid development of global economy, showed by the development of all industrial sectors, has made the popularity of EPC project procurement increase. The need for EPC projects has been influenced by some factors, namely: the population growth, the nation’s economy growth, and the sustainable development concernment.

Huse (p. 17) [4] wrote that the use of turnkey and EPC contracts for construction projects, and in particular infrastructure projects, has become more popular with employers and financing institutions recently. However, although this approach is growing popularity and provides many advantages to these entities, it also has several disadvantages. Table 1 below describes the advantages and disadvantages of EPC procurement system.

Table 1: Advantages and Disadvantages of EPC

Advantages	Disadvantages
Single point responsibility	Employer’s loss of control
Price and project duration certainty prior to construction	Need a strong commitment
An improved degree of buildability	Cost management difficulties
Fitness for purpose	Tender comparison difficulty
Speed of procurement	Cost of tender
Efficiency	Cost of risks
Reduce claim opportunity	Difficulty in issuing variation order
Easy administrative	Bidder resistance

The History and Development of Project Delivery in Indonesia

For almost 67 years after its independence, Indonesia has made development in many sectors. One of the most visible sectors to see this development is the construction industry. Many high rise buildings and big civil engineering works have been executed. This is the result of the cooperation between government and construction industry players as well as the role of Indonesian citizen.

The history of project delivery in Indonesia starts since its independence until today. Jakarta as the capital city of Indonesia has shown the major development in construction industry with its high rise buildings and wide highways. Many of these projects were executed using the traditional procurement method. However, following the development of construction industry in the world, the other procurement methods have also been introduced in Indonesia. Juanda International Airport at Surabaya and Sepinggan Airport Package 1 at Balikpapan for example, both use *design and build* type of procurement system. Moreover, due to its economic growth, the construction activities are not only done in the capital city, but also have reached other cities as well, mainly in Medan, Surabaya, Makasar, Batam, and Bandung.

Meanwhile, the development of EPC procurement system also has a long history which is shown by the establishment of PT Rekayasa Industri (Rekind). On 12 August 1981, Indonesian government established PT Rekayasa Industri in order to develop national capabilities in engineering, procurement, construction and commissioning (EPCC) for large industrial plant into a world-class capability. Today PT Rekayasa Industri is one of the leading EPCC companies in Indonesia.

This expectation is applicable since Indonesia is known as the second largest construction market up to 2010 in Asia after China. The market covers infrastructure and property investment both under government spending and or private investment as discussed by Suraji and Krisnandar [5].

EPC Projects

EPC projects have been executed and developed along with the development of industry world. As long as there is a process covering engineering, procurement and construction activities in a particular project, this project is considered as an EPC project. However, even when these activities are done in a building project, it is not considered as an EPC type of procurement but a '*design and build*' type of procurement.

Meanwhile, the usage of some other terms needs also to be defined. Lump sum, turnkey, design and build, and EPC are often used together and concurrently. However, there are slight differences between these terms. *Lump sum* is a contract to complete work for a set amount agreed upon before the work begins. It gives a price for the whole of the contract, irrespective of the contractor's actual cost. Although literally it bears the implication to give a single payment of money (upon the completion of the project), in practice the contractor will usually be paid in installments, whether based on a schedule of payment or at specified stages of completion (milestone). The difference with EPC is that lump sum is a payment-method-related term. Therefore, EPC contracts are normally use but not limited to lump sum method.

Turnkey by definition refers to something that is ready for immediate use. Everything is completed as the employer's requirements. It bears the same implication with EPC definition. There is no difference between these two terms, except that turnkey is used more widely while EPC is used only for EPC projects. The same case happens between the term of design and build (DB) and EPC. *Design and build* is normally used for building projects. Despite this, EPC projects are often more complex and larger than building projects. This will result in differences of characteristics between

EPC and building projects.

The development of EPC projects in Indonesia itself, besides motorized by the growth of the nation economy and the demand of EPC construction, is also supported by the natural resources available in the country. Since EPC projects are generally complex, high technology and natural resources-related industry, the availability of such natural resources will enhance the demand of EPC projects. With this rapid development and demand of this industry, it will influence the need of EPC projects and will eventually increase the popularity and used of EPC type of procurement.

Consequently, it is crucial for those undertaking these types of projects to understand the unique characteristics and risks that are associated with the EPC procurement system and EPC projects (Nelson, 2006). The idea behind the EPC or turnkey approach is simply, for the contractor to be given the job to engineer, procure and construct the required works and to hand over the keys to the employer once it ready for operations, so they may operate the facility as wrote by Hosie [6]. In relation to cost efficiency, Hui An and Qin Shuai [7] have concluded that the general contractor of EPC project can control the costs of the project from engineering, procurement and construction stages. Meanwhile, the importance of contract management in managing EPC projects has already been discussed by Kyle Costa [8].

EPC Project Life Cycle

A project life cycle is a collection of generally sequential and sometimes overlapping project phases whose name and number are determined by the management and control needs of the organization(s) involved in the project, the nature of the project itself, and its area of application. The project life cycle can be determined or shaped by the unique aspects of the organization, industry or technology employed. While every project has a definite start and a definite end, the specific deliverables and activities that take place between will vary widely with the project. The life cycle provides the basic framework for managing the project, regardless of the specific work involved (PMI, 2008).

Figure 3 below illustrates the typical EPC project life cycle. The engineering phase starts from the concept design until the work planning activities. Procurement phase deals with material and plants procurement, while construction phase deals with the actual construction activity.

Engineering phase consists of sub-phases which need to be done step by step from conceptual, basic engineering until detail engineering. This phase has a high influence to other next phases since many planning and decisions need to be made correctly at this phase.

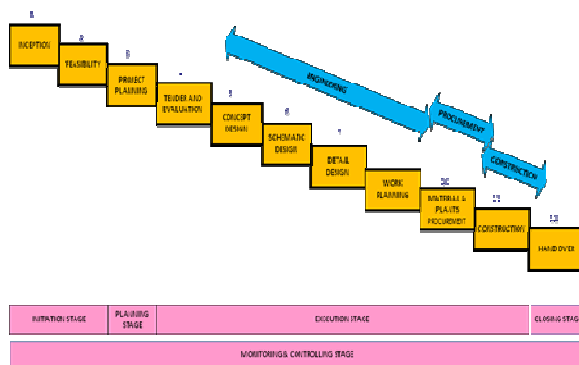


Figure 3: Typical EPC Project Life Cycle

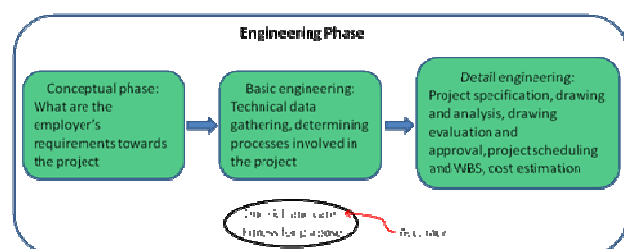


Figure 4: Engineering Process

Procurement is a purchasing or procuring materials and equipments process which is needed from outside project team in order to finish the project. In EPC projects, procurement does not mean only procuring materials and equipments for the purpose of the construction, but in a more specific scope, it means procuring materials and equipments needed for what the project is intended for. For example, in power plant project, the contractor must procure machines, plants and raw materials needed so that after the completion of the project and when the plant is activated, it will give output as what has been required in the contract. In short, unlike building or civil work projects which give a product, EPC projects give a system as their outputs.

Construction is a process to use all materials and equipments available to construct a project complete with its installation in an efficient way and based on the engineering phase output. It involves two activities; physical activities and non physical activities. Physical activities include site preparation works, fabrication works, installation works, construction works, testing and commissioning. Non physical activities include construction planning, controlling, supervising, inspection and administration.

METHODOLOGY

This research is mainly based on literature reviews, case studies and interviews. Literature review is a literature sourced from books, journals and other media that aims to develop the basic theory that will be used in conducting the research. Case studies can be defined as analyses of events, projects, policies, or systems which are studied holistically by using one or more research methods. An interview can be defined as a verbal interaction between the interviewer (which is the researcher) and the interviewee(s) where the first (the interviewer) implicitly directs the flow of information to get the objectives of doing interviews.

There are 6 (six) projects which have been used for the purpose of this research. Data gathering was conducted through direct visit to PT. Waskita Karya (Persero) EPC Division and via email. The visit was conducted on 2nd July 2012. The data taken is only company and project data related with the analysis and necessity of this research. Another way of collecting the data needed for this research is by interviewing key personnel of EPC related background. There are 4 (four) key personnel consist of 3 (three) persons from EPC Division and the other from Division 1. Semi structured interviews were done for this purpose.

Project data analysis will be done by case study approach where project comparison will be the main method of doing the analysis. This comparison analysis is done in order to identify and understand the characteristics and implementation of EPC projects in Waskita. From that then there will be discussions about problems and ways to overcome them so that they will improve the effectiveness of the business process for EPC projects.

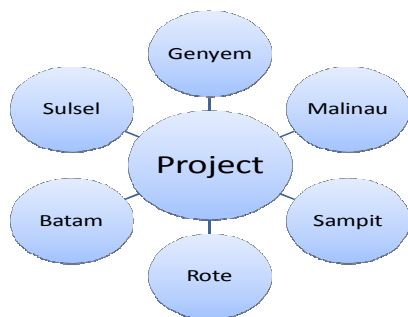


Figure 5: Project Data Available

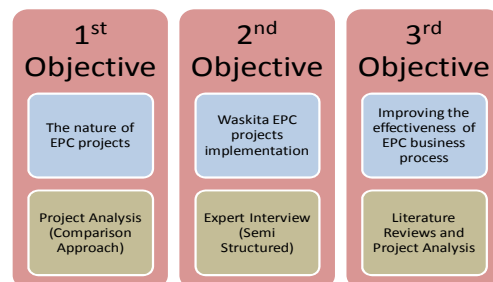


Figure 6: Data Analysis Approaches

RESULTS

There are 6 (six) available project data which have been taken from Waskita. Out of 6 (six) projects, only 1 (one) has been completed, i.e. Marine Structure Construction of Coal Unloading Jetty PLTU Sulawesi Selatan 2x50 MW Project. It was also a complete EPC project. Meanwhile, Genyem Hydro Power Project 2x10 MW and PLTU Malinau 2x3 MW are still on progress. For these projects, Waskita EPC division only covers the engineering and procurement phases (E-P), while the construction phase is given to other divisions. For Genyem Hydro Power Project, the construction phase is taken by division II and for PLTU Malinau Project, the construction phase is given to division V.



Figure 7: Project Data Distribution

Table 2: The Availability of Project Data Type

No	Project Name	Contract Document	Risk Management	Problems Report	Presentation	Photo
1	Rote CFSPP Project 2x3 MW	V	V	V		
2	Batam 2x60 MW Coal Fired Power Project - Package 1	V	V			
3	Marine Construction PLTU Sulawesi Selatan 2x50 MW Project	V	V	V	V	V
4	PLTU Sampit 2x25MW Project	V	V	V	V	V
5	PLTU Malinau 2x3 MW at East Borneo	V	V	V	V	V
6	Genyem	V	V	V	V	V

The data that was taken by the researcher consists of the following documents, namely: Contract Documents, Project Risk Management, Project Problems Report (Form. Prod 04), Project Presentation and Photo Documentation.

The Nature of EPC Projects

The characteristics of EPC projects can be summarised from the above cases by comparing the similarities of project's agreements and implementations. From this comparison, it can be concluded 3 (three) main categories of EPC project's characteristics, namely: general aspect, legal & contractual aspect, and technical aspect.

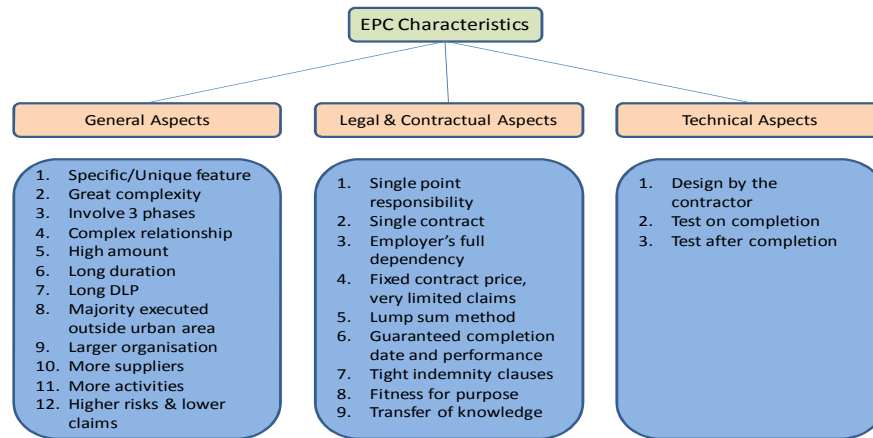


Figure 8: EPC Project's Characteristics (Based on Project Analysis)

Besides the above characteristics, there are some other EPC project's characteristics which are not derived from the project analysis. Table 3 below shows these characteristics.

Table 3: EPC Project's Characteristics (Not Based on Project Analysis)

Production Driven	Clear and Simple Division of Obligations and Liabilities
High offsite scope	Value Engineering
Extensive performance criteria	Must up to date with the current technology
High standard of safety procedure	Necessity of complete design
Square project criteria	Transfer of project to third party

From the above lists, some characteristics can be drawn to describe the specific characteristics which can only be found in EPC projects, i.e. (a) involves 3 phases (EPC), (b) more suppliers, (c) more activities, (d) transfer of knowledge, (e) design by contractor, (f) test after completion, (g) production driven, (h) high off site scope, (i) square project criteria, and (j) transfer of project to 3rd party.

EPC in Waskita

In August 2011, Waskita as one of the leading construction companies in Indonesia has established a division which focus on EPC projects. Seeing the increase of EPC projects in the recent years has made Waskita to see the opportunity to become a player in this industry. Below are some reasons why Waskita decided to establish EPC division:

- Waskita has some experiences in doing EPC projects before
- Waskita has already build network in the industry
- There are still not many companies compete in this type of projects
- The necessity for EPC projects are always increasing (many factors)
- EPC projects have different characteristics with other types of project
- Opens up the chance to participate in global arena

EPC projects in Waskita are quite different in their implementation. Some projects which are handled by EPC only cover engineering and procurement phases, while construction phase will be executed by other divisions. For projects

with this kind of strategy, EPC portion will be split based on its weight of work. Moreover, Waskita has made a strategic plan for EPC Division development. Starting from 2009 as EPC subcontractor, it has aimed to become a full EPC main contractor in 2014.

Improving the Effectiveness of Business Process for EPC Projects

From the above descriptions about the nature of EPC projects and their implementation in Waskita, some insights and strategies to improve the effectiveness of EPC project delivery can be summarised. Here, these insights and strategies are grouped into 3 (three) categories, namely:

- Insights and strategies for the contractor
 - Build a strong and solid in-house technical expertise or engineering team
 - Start to record their on-going and future EPC projects, and collect their previous EPC projects
 - Do sharing knowledge
 - Develop safety alertness on the project site
 - Implement Good Risk Management
 - Implement Good Project Management
 - Implement Good Quality Management
 - Implement Good Dispute Management
 - Develop a corporate standard or procedure specifically focuses on EPC projects
 - Have a good record and awareness of future projects
 - Make a tender evaluation to see the trend of contractor performance in winning the EPC tenders
 - Make a SWOT analysis
 - Record subcontractor and supplier database
 - Develop concurrent engineering technique
 - Ensure that the variations and extension of time procedures have been followed
- Insights and strategies for the employer
 - Must select the right EPC contractor
 - Must understand that problems will always occur in any project, especially in EPC projects which are very complex and involve numerous players
 - Develop an in-house engineering team
 - Reply any design review and comment as soon as possible
 - Must understand the reason to avoid the cost overrun

- Insights and strategies for both parties
 - Must understand commercial aspects of the contract, the basic principles of contractual arrangement and tendering system
 - Use and understand international and recognised standard forms of EPC contract
 - Keep a simple and close relationship. Develop a good communication and coordination between all parties
 - Use other contracting strategies such as EPC- LLIs, EPCM, and Partnership
 - Use the development of Information Technology to monitor progress
 - Understand possible disputes in EPC projects

CONCLUSIONS

The central of this research is EPC projects analysis in order to identify the nature of EPC projects, how EPC projects have been implemented in Waskita, and what are some insights and strategies to improve the effectiveness of EPC projects.

The findings show that there are at least 24 (twenty four) characteristics which can be concluded from the available project data, plus 10 (ten) characteristics not derived from project data. Out of these 34 (thirty four) characteristics, 10 (ten) of them can be considered as specific characteristics which can only be found in EPC projects.

And since Waskita has just recently established EPC division, the implementation of EPC projects in Waskita is quite different for some projects in which they may not involve in a complete process of EPC procurement, i.e. engineering, procurement and construction.

Meanwhile, this research also finds that there are at least 15 (fifteen), 5 (five), and 6 (six) strategies that can be implemented by the contractor, the employer, and both parties respectively.

Since EPC project is very complex by its nature, a good knowledge management and innovation implementation will improve its effectiveness. Researches focus on performance liquidated damages (PLD) in EPC projects; EPC contractual aspects; possible claims and variation orders in EPC projects; and possible disputes and disputes settlement of EPC projects are also important to give description on how to deal with EPC projects for all players in the industry.

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